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ABSTRACT

This student guide provides materials for a course designed to instruct the student in the recommended procedures used when setting up tooling and verifying part programs for a two-axis computer numerical control (CNC) turning center. The course consists of seven units. Unit 1 discusses course content and reviews and demonstrates set-up procedures for various tool length compensation methods. Unit 2 instructs the student in methods of recovering from emergency stop or feed hold conditions, the trial run of a part, and methods of adjusting machined dimensions using program editing and offset register adjustments. Unit 3 lists almost all the errors that the student may encounter. In units 4-7, the student performs a set-up and program verification of the following: (1) a CNC program using point to point and linear interpolation programming methods; (2) two more CNC programs while being introduced to the concepts of tool nose radius compensation; (3) a CNC program using circular interpolation methods; and (4) a CNC program using metric units of millimeters for positional data. Contents of each unit include an introduction, list of objectives, contents, and materials for three sections. These sections contain narrative instructional materials, an assignment section that requires written answers, a project section with instructions and necessary data sheets, and competency check list. (YLB)

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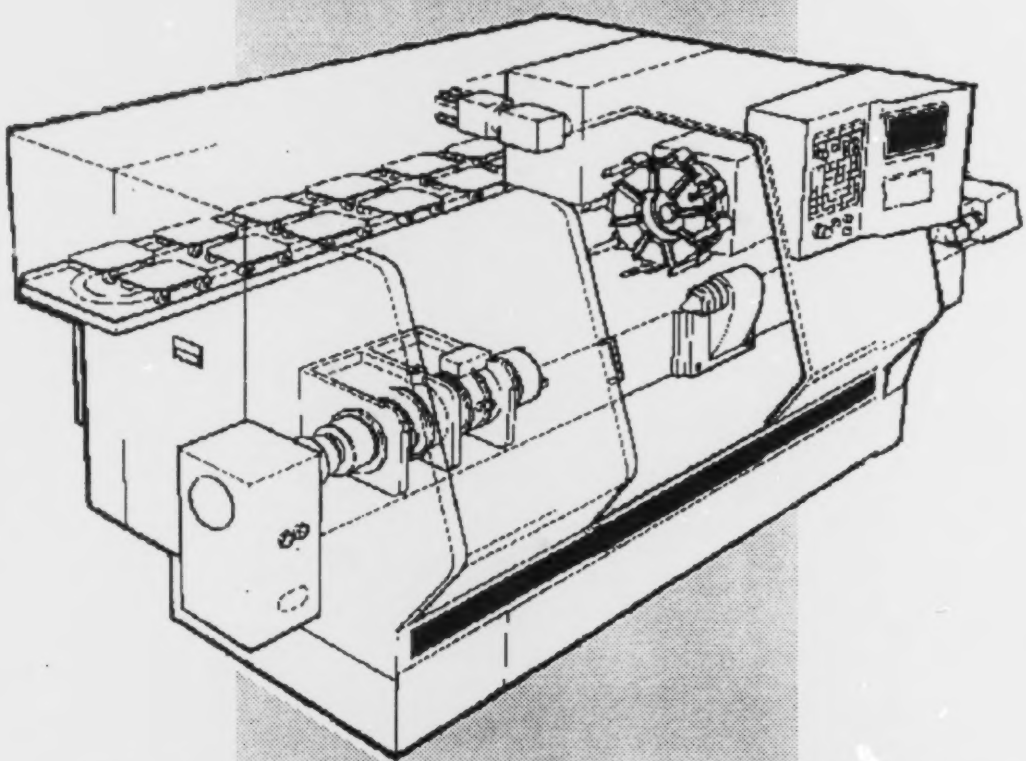
# CNC TURNING CENTER OPERATIONS AND PROVE OUT



## COMPUTER NUMERICAL CONTROL OPERATOR/PROGRAMMER

## 444 - 334

By STEVEN D. SKOWRONSKI

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444-334 CNC Turning Center Operations and Prove Out

**Unit 1**

**Introduction and Setup Procedures**

INTRODUCTION

This course is designed to instruct the student in the recommended procedures used when setting up tooling and proving out part programs for a 2-axis CNC turning center (TC).

In this operations and prove out course the student will utilize CNC documentation and part programs created by the student themselves in course 444-333 CNC Manual Programming Turn 1, as well as part programs provided by the instructor. The student will exercise and expand on the setup and prove out procedures first introduced in course 444-332 CNC Turning Center Operations.

In this unit, we will discuss the content of this course and review and demonstrate setup procedures for various tool length compensation methods.

OBJECTIVES

At the completion of this unit the student will be able to:

1. Discuss the course syllabus and course expectations.
2. Demonstrate setup procedures for the G50 tool preset method.
3. Demonstrate setup procedures for the G54 work offset method with tool geometry offsets.
4. Explain the steps for program prove out.

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Section 3 Program Prove Out

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Project NC334.1 Setup and Dry Run Only
G50 Method
G54 Method

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**SECTION 1**

Course Syllabus
CNC Turning Center Operations And Prove Out
(444-334)

Instructor: _____ Phone: _____

Office: _____ Office: _____

Course Structure: 12 hours in CNC shop per week
(to include lecture periods as needed)

Textbook: CNC Turning Center Operations and Prove Out
by Steven D. Skowronski
(MATC Courses 444-334)

Required Materials: One 3-ring Notebook
Safety Glasses

Reference Materials: HITEC-TURN 25S/25S-1100 CNC Lathe
Instruction Manual

Grading Policy: 25% quizzes and student exercises
50% course projects
25% final projects

Attendance: Daily attendance in this course is mandatory.
School policy for attendance will be followed.

| WEEK | DATE | UNIT OF INSTRUCTION |
|---|---|---|
| 1 | _____ | Introduction to CNC Turning Center Operations and Prove Out With Alternative Tool Setup Methods |
| 2 | _____ | Program Prove Out and Error Recovery |
| 3 | _____ | Error Codes |
| 4 | _____ | Point to Point and Linear Interpolation |
| 5 | _____ | Tool Nose Radius Compensation |
| 6 | _____ | Circular Interpolation |
| 7 | _____ | Metric Parts |

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COURSE DESCRIPTION

As a CNC programmer you may be allowed the freedom of developing all of the machining methods and sequence of operations necessary to complete the machining of a piece of raw material into the final product. You may be designing and developing various workholding devices to accomplish several setups on a single machine tool or a variety of different CNC machine tools. As a programmer you may be writing the several different programs required for a multitude of operations across several different CNC machining centers. Numerous documentation files must be maintained and distributed to communicate the required tooling and workholding devices as well as the correct setup procedures for successful setup, prove out and run the final program. As a programmer you may be the only person who has the complete picture of how all the pieces of several different operations fit together to culminate in the correctly machined final product.

Yet as a programmer, busy with many projects, you may not be involved with the first run or prove out of your program. Another programmer may get involved because of shift schedules. In some cases machine operators may have the responsibility of performing the prove out function. As an operator/programmer your primary job function may be to setup CNC machines and included with your job responsibilities the setup and prove out of new CNC programs.

If you are the author of the CNC program you are about to prove out, you probably know by heart the sequences of every axis movement that will occur including the reasons behind unusual prepositioning methods and operation sequences. But, for one of the reasons given above you may find yourself proving out a program you have not written, for a part you may not have seen before, on a dedicated fixture which has just been built or some other workholding setup as described in the documentation.

As you can imagine in situations like this the prove out of a new and unfamiliar CNC program can be an apprehensive exploration of the limits and boundaries of your machine tool filled with annoying occurrences of tool breakage, machine interference (collisions) and unexplainable axis limit errors. The prove out of a CNC program can be the most dangerous time for the machine tool and operator alike in terms of physical damage and for the programmer in terms of job security. However, the dangers can be minimized and production maximized by following practical steps or procedures of program prove out.

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This course will embark on projects which will exercise these prove out techniques to the pointwhere you as an operator/programmer will be able to confidently and successfully prove out a CNC horizontal machining center program whether you authored it or someone else did. Also in cases where unforeseen errors do occur this course will introduce you to ways of recovering from these situations.

**SECTION 2**

MACHINE SETUP REVIEW

1. Display the directory and call up the required program. If the required program is not in the controller's memory then load the program using either the tape reader and program tape, or use the RS232 communication port and up load from the programming station.

2. Read the new program into memory. Page through it and check it against the program manuscript.

3. Zero Return both machine axes.

4. Install all workholding devices as specified in the setup sheets.

5. Remove the tools from the previous setup and install the tools specified in the tooling lists.

6. Set the work offsets as outlined on the setup sheet.

7. Set the tool length offsets as specified on the setup sheet and record these on the tooling list.

G50 Method and the G54 method will be covered more extensively in class.

**SECTION 3**

PROGRAM PROVE OUT

The following is a sequence of steps that allow the safe prove out of a CNC program. In cases of program familiarity some steps can be combined or eliminated, but these procedures when followed 100% will prevent damage from occurring to tools, workholding devices or piece parts as a result of programming error.

1. Inspect the workholding setup and tooling to ensure they comply with the documentation.

2. Compare the program manuscript with the tooling list or tool turret to verify that the program calls for the tooling in the same positions that it has been loaded into the tool turret.

3. Set the control panel switches to the proper status for the prove out.

   a. Check the program for any slashes preceding a block of program code. Determine if these blocks should be ignored during the dry run. Engage the Block Skip Switch to the on position if they need to be skipped.

   b. Switch the coolant switche to off.

   c. Set the Feed Override and Spindle Override switches to 100%.

   d. Set the Rapid Override switch to 25%.

e. Set the Single Block switch on.

f. Set the Dry Run switch to on.

g. All other panel switches should be set to the off position.

The coolant is turned off so that the operator can see the positioning movements of the tool point. The rapid override is set at 25% to allow the operator enough reaction time for errant moves. This is also to reduce impact forces and resulting damage if the errant move is not stopped in time. The single block is on to stop program execution at the end of every block. This allows that operator to look at the CRT and read the next line of the program before it is executed. The operator can then determine if the next movement is consistent with where the tool point is now located in relation to the part or machine and make a judgement on whether to continue or edit the program. The dry run condition will cause the feed rate axis movements to feed at the rate the rapid override switch is set at.

4. Push cycle start to begin first dry run. Keep your hand near the feed hold button in case any thing looks wrong. During this dry run look for gross axis movements which seem out of place.

   If you catch any errors use the feed hold to stop program execution. Determine how to correct the error. Reset the control. Home the machine. Put the mode switch to edit and modify the program. Put the mode switch back to memory. Position the cursor to the line that is the safe start line for the tool that was interrupted, this is usually the line following the M01 of the previous tool. Push cycle start. Repeat this procedure as needed.

5. At the completion of the first dry run cycle ensuring that all edits were executed during the first dry run, Reset the program.

6. Load the piece part into the chuck per the setup sheet.

7. Set the dry run switch to off. (But leave the rapid override set at 25%.)

8. Set the coolant and oil mist switches to Auto.

9. The third run will actually be cutting metal at 100% feed and spindle rates but with reduced rapid rates to allow for sufficient reaction time in case if trouble. The single block mode is still in effect. This will allow you to manually turn off the coolant during a cycle stop in between blocks and visually verify the position of the tool point. The trial run performs two functions. The first is a verification of a safely executed program under close supervision or monitoring by the operator. Any errant moves not caught in the dry runs will show up here as tool breakage or graze marks on the part or machine components. Excessive feed rates or spindle speeds which become apparent through noise, vibrating, or excessive horsepower are adjusted by the operator using the override switches. At this time the operator only adjusts the feeds or speeds downward to reduce stress on the machine or part. The operator should note these settings and edit the program at the end of the trial run.

   The second function of this trial run is to verify that the part has been machined to the dimensions specified in the print specifications or by the programmer.

10. The part should be completely inspected. Adjustments should be made to tooling as required. Wear offsets for tooling should be entered to compensate for deviations in depth of holes, length of linear dimensions or diameters.

Steps 9 and 10 should be repeated until the part meets the spec. Subsequent trial runs can be done with the single block switch set to off and the Rapid Override set at 100%.

14. Optimization is optional for short run or one time only jobs. Optimization is a requirement for high volume or frequently run production jobs. During optimization the programmer should ask these four questions:

    a. Can the feed or speed be increased without affecting optimum tool life or without affecting the quality of the product?

    b. Can changes in the tooling be made to reduce cycle time?

c. Is the machine tool being operated correctly and a quality product being produced?

d. Is the operation being performed safely?

Optimizing techniques involving increasing feeds and speeds can be performed during the trial run cycles while trying to obtain a part properly machined to specifications. To avoid over stressing tooling during optimization cycles the following procedures should be followed:

i) Surface finish is a function of feedrate and tool nose radius. Adjust feedrate upward to the point where the surface finish is not compromised. Then spindle speed can be adjusted upward. By increasing the depth of cut in some cases less roughing passes can result.

ii) Increase the overrides gradually until the maximum cutting speed has been reached or until signs of stress appear. The maximum cutting speed can be found in machinability data books for materials and cutting tool configurations used. Signs of stress include heat build up in the part or in the tool, poor or galled surface finish, build up or burning of the cutting tool edges. Chatter usually means the feedrate is too low or depth of cut too shallow, or a lack of rigidity in the tool assembly or workholding device.

iii) With each feed or speed adjustment calculate the horsepower requirements or observe the horsepower meter during operation. If the horsepower limits are exceeded, the spindle could stall or the axis clutches could disengage. This will usually result in a damaged tool. By keeping horsepower requirements at a level of 50% to 80% of the spindles' continuous operation horsepower range the above problem can be avoided.

iv) Edit the program to account for the override settings.

v) Reset the overrides to 100%.

vi) If the machine is well within the horsepower limits

then continue to increase the spindle speed override only. Do not exceed the maximum chip load or feedrate provided by the machinability data. Otherwise increase until signs of stress occur and then back off about 10%.

vii) Edit the program for the appropriate feedrate and set the override to 100%.

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ASSIGNMENT SECTION:

Prove Out Procedures

1. Why is program prove out necessary?

2. During the prove out process the program is executed several times. List the names of these different runs and the purposes for each one.

3. What is the horsepower at the spindle for continuous operation?

4. Proof read the program in the project section to check tool list data against program data. If there is a difference determine which is correct and update the document containing the error. Specify what you did below.

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PROJECT SECTION:

Project NC334.1

1. Set up the following project according to the setup instructions.

2. Review the program and fill in the description area as indicated.

3. Perform the tape check and dry runs.

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| CNC PROGRAM PROVE OUT EVALUATION | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | Unit No. | | Student | | |
| Part Name | | Mach.No. | | Date | | |
| Work Zero Offset | G | X | Z | | | Eval |
| | | | | | | 5 |
| Workholding | Hard Jaws Soft Jaws Face Plate<br>Assembled Machined | | | | | 5 |
| Tool Length Offset Geometry | | | | | | |
| Tool No. | G50 or G54 | | Assm. | Ver. | In Pkt. | 10 |
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| Prove Out | Collision Broken Tool Scrapped Part Damaged Part | | | | | 20 |
| | Fluid Low: Hyd Way Coolant | | | | | |
| | List Alarms: | | | | | |
| | Speeds: Low High OK | | | | | |
| | Feeds: Low High OK | | | | | |
| Document-ation | Legible Logical | | | | | 10 |
| | | | | | Total | |

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| Inspection Report | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | St dent | | Date | | Eval |
| Edge Location | | | Finish | | | 10 |
| Nominal Dimension | Tolr. | Actual Dimension | Out of Tolr. | Comment | | 40 |
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**Unit 2**

**Error Recovery and Trial Run**

INTRODUCTION

This unit will instruct the student in methods of recovering from emergency stop or feed hold conditions due to non-crash conditions such as slide limit errors or operator intervention and crash conditions such as tool breakage or machine impacts.

The student will also receive instruction in the trial run of a part and methods of adjusting machined dimensions utilizing program editing and offset register adjustments.

OBJECTIVES

At the completion of this unit the student will be able to:

1. Recover from an E-Stop condition.

2. Recover from a power loss condition.

3. Restart the program after moving the tool out of the programmed path for purposes of collision avoidance and/or program editing.

6. Trial run the first work piece for correct feeds and speeds.

7. Edit speeds or feeds as required.

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Reference Section:

Section 1 Error Recovery

Assignment Section:

Error Recovery

Project Section:

Project NC333.1 Trial Run

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**SECTION 1**

ERROR RECOVERY

Under certain conditions during program prove out the operator will find it necessary to interrupt the program either to prevent a collision or as a result of a collision or tool breakage. Occasionally the machine will interrupt itself as a result of an axis over travel. From any one of these conditions it is necessary that the operator be able to safely recover the machine tool and restart the program.

During the prove out the operator should always have one hand on the Feed Hold button ready to stop axis movement in case of an emergency. The feed hold can be used in all cases to stop axis movement except when executing a threading or tapping cycle. The feed hold suppresses axis movement only, and the spindle continues to rotate. If a feed hold could be executed during a tapping cycle and forward motion was halted after the tap began cutting metal the spindle would continue to rotate causing the tap to break or causing the threads to be damaged.

During tapping operations the operator should reposition his/her hand to the E-stop button on the control. It is extremely important that if the tap breaks or if it looks like it will be tapping excessively deep that the E-stop button be pressed. If the operator loses concentration or for some other reason does not have a ready hand on the E-stop button and the tap breaks the RESET button will work to prevent further damage also.

RECOVERY FROM AN E-STOP

When the E-Stop is pushed in, the axis drive motors are shut down and spindle rotation is stopped. The controller resets to the "initial control on" parameters. The machine tool must be zero returned or a reference point return must be performed.

1. Clear the emergency. Do this by determining the cause of the emergency. For example: wrong positioning coordinates causing a collision with the fixture or a broken tap from bottoming on a blind hole. Then release the E-Stop and manually position the turret clear of the spindle and part.

2. Orient the machine by homing the axes.

3. Edit necessary corrections to the program.

4. Prepare or repair the chuck, part or tooling. Change the offset value if necessary.

5. Select Memory mode.

6. Press the function menu key and press the soft key PRGRAM to display the program.

7. Press the operation menu key and press the soft key REWIND.

8. Input the sequence number of the block from which the program is to be restarted.

9. Press the soft key FRWRD SRCH and the system will search for the specified sequence number.

10. Press the cycle start button.

RECOVERY FROM A LOSS OF POWER

As soon as a loss of power is experienced, press the E-Stop to prevent any axis or spindle movement from occurring if the power comes on suddenly. Turn off the main electrical disconnect. This prevents surges to the equipment when the power comes on line again. Once power is available, start the machine normally, orient the axes, check all offsets for correct values. Follow the procedures outlined in recovery from an E-Stop.

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PROJECT SECTION:

Project NC333.1

Perform the trial run.

COMPETENCY CHECK OFF:

| DATE | INSTRUCTOR | |
|---|---|---|
| _____ | _____ | Perform trial run on Project 326.0. |
| _____ | _____ | Simulate an E-Stop and perform a recovery operation. |

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**Unit 3**

**Error Codes**

INTRODUCTION

Many combinations of errors can occur within a CNC program and the controller has been provided some analysis tools in anticipating errors of format, logic, syntax, and monitorring the machine tool systems for dangerous operating conditions such as spindle overload, or low hydraulic oil. These errors will show up as messages on the screen after the controller has sensed an alarm condition and halted execution of the CNC program. Many messages only display the error code and maybe a short general statement. You the operator will have to look up the error code and decide the apropriate action to clear the alarm or correct the program.

This unit provides you with almost all the errors you may encounter and will be valuable to you for the next few programming courses. Sometimes an error code occurs and it will not be found on your list, please tell your instructor. These errors may be diagnostic errors that originate from the actual electronic circuitry and will only be found in the maintenance manuals provided for the machine.

OBJECTIVES

At the completion of this unit the student will be able to:

1. Explain the causes of the more common errors that occur during the prove out process.

2. Become familiar with the most frequent occuring error codes.

3. Be able to extrapolate information from the sparse error message given in the manual.

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| PS 003 | TOO MANY DIGITS | Data exceeding the allowable number of digits was input. |
| PS 006 | ILLEGAL USE OF NEGATIVE VALUE | Sign "-" was specified in an address where no sign "-" is allowable, or two signs "-" were specified. |
| PS 007 | ILLEGAL USE OF DECIMAL POINT | A decimal point "." was specified in an address where no decimal point "." is allowable, or two decimal points "." were specified. |
| PS 010 | IMPROPER G-CODE | An illegal G code was specified. This alarm also occurs, when a G code corresponding to an unadded option was specified. |
| PS 011 | IMPROPER NC-ADDRESS | An illegal address was specified. |
| PS 012 | INVALID BREAK POINT OF WORD | NC word delimiter is in error. |
| PS 013 | ILLEGAL PROGRAM NO. POSITION | Address O or N was specified at an illegal position (after a macro statement, etc.). |
| PS 014 | ILLEGAL PROGRAM NO. FORMAT | Address O or N was not followed by a number (numeral). |
| PS 015 | TOO MANY WORDS IN ONE BLOCK | The number of words in a block exceeded an allowable range. |
| PS 016 | EOB NOT FOUND | EOB (End of Block) code is missing at the end of a program which was input in MDI mode. |
| PS 017 | ILLEGAL MODE FOR GOTO/WHILE/DO | GOTO statement or WHILE-DO statement is contained in an MDI or tape mode main program. |
| PS 058 | S-COMMAND OUT OF RANGE | A specified spindle speed exceeded the maximum spindle motor speed (data No. 5619). (when data No. 5601 parameter SAL is 1). |

(Note) PS××× shows a program/setting alarm generated in the foreground. A background alarm number corresponding to PS××× is displayed as BG×××.

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| PS 060 | SEQUENCE NUMBER NOT FOUND | A specified sequence number was not found in sequence number search. The sequence number specified by GOTOn or M99pn was not found at the jump destination. |
| PS 061 | NO P, Q COMMAND AT G70-G72 | Neither P nor Q was specified in the block of multiple repetitive cycle G70, G71 or G72 for turning. (P : Sequence No. for a cycle start block, Q : Sequence No. for a cycle end block) |
| PS 062 | ILL COMMAND IN G70-G76 | A command in the block of multiple repetitive cycle (G70 ∿ G76) for turning is improper. |
| PS 063 | P, Q BLOCK NOT FOUND | A sequence No. block for P or Q specified in the block of multiple repetitive cycle G70, G71 or G72 for turning cannot be found. |
| PS 065 | ILL COMMAND IN P-BLOCK | A command in the sequence No. block for P specified in the block of multiple repetitive cycle G70, G71 or G72 for turning is improper. |
| | | |
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| | | |
| PS 076 | PROGRAM NOT FOUND | The program whose program number was called by M98, G65, G66, G66.1 or G/M/T code cannot be found. |
| PS 077 | PROGRAM IN USE | A program being edited in the background was called to be executed in the foreground. |
| PS 090 | DUPLICATE NC, MACRO STATEMENT | NC statement and macro statement were specified in the same block. |
| PS 091 | DUPLICATE SUB-CALL WORD | A subprogram call command was specified twice or more in the same block. |

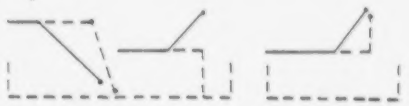
| Error code | Message displayed on CRT | Contents |
|---|---|---|
| PS 092 | DUPLICATE MACRO-CALL WORD | A macro call command was specified twice or more in the same block. |
| PS 093 | DUPLICATE NC-WORD & M99 | An address other than O, N, P, and L was specified in the same block as M99 under the macro modal call mode (G67). |
| PS 094 | USE "G" AS ARGUMENT | Address G is being used as a macro argument. |
| PS 095 | TOO MANY TYPE-2 ARGUMENT | Eleven arguments or more were specified in custom macro argument specification II. |
| PS 100 | CANCEL WITHOUT MODAL CALL | Call mode cancel (G67) was specified not in the macro modal call mode (G66). |
| PS 110 | OVERFLOW: INTEGER | An integer exceeded $-2^{31}$ ($2^{31}-1$) in an arithmetic process. |
| PS 111 | OVERFLOW: FLOATING | A binary floating decimal point range was exceeded in an arithmetic process. |
| PS 112 | ZERO DIVIDE | Division was specified with a divisor "0" (Custom macro). |
| PS 114 | VARIABLE NO. OUT OF RANGE | An unusable variable number was specified (Custom macro). |
| PS 115 | WRITE PROTECTED VARIABLE | A variable employable only on the right side of an expression was employed on the left side of the expression (Custom macro). |
| PS 116 | READ PROTECTED VARIABLE | A variable employable only on the left side of an expression was employed on the right side of the expression. (Custom macro) |
| PS 118 | TOO MANY BRACKET NESTING | Multiplicity of brackets exceeded an allowable range. (Custom macro) |
| PS 119 | ARGUMENT VALUE OUT OF RANGE | An argument of a function exceeded an allowable range. (Custom macro) |
| PS 121 | TOO MANY SUB, MACRO NESTING | Total multiplicity of subprogram call and macro call exceeded an allowable range. |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| PS 122 | TOO MANY MACRO NESTING | Multiplicity of macro call exceeded an allowable range. (Custom macro) |
| PS 123 | MISSING END STATEMENT | END command corresponding to DC command is missing. (Custom macro) |
| PS 124 | MISSING DO STATEMENT | DO command corresponding to END command is missing. (Custom macro) |
| PS 125 | ILLEGAL EXPRESSION FORMAT | An expression format is illegal. |
| PS 126 | ILLEGAL LOOP NO. | DO and END No. exceeded an allowable range. |
| PS 128 | SEQUENCE NO. OUT OF RANGE | A sequence number is other than 1-∿ 9999. |
| PS 131 | MISSING OPEN BRACKET | The number of brackets "[" is smaller than that of those "]". (Custom macro) |
| PS 132 | MISSING CLOSE BRACKET | The number of brackets "]" "[" is smaller than that of those "[". (Custom macro) |
| PS 133 | MISSING "=" | Command "=" is missing. (Custom macro) |
| PS 134 | MISSING "/" | Command "/" is missing. (Custom macro) |
| PS 135 | MACRO STATEMENT FORMAT ERROR | Macro statement format is erroneous. (Custom macro) |
| PS 136 | DFA STATEMENT FORMAT ERROR | Macro DFA statement format is erroneous. (Custom macro) |
| PS 137 | IF STATEMENT FORMAT ERROR | Macro IF statement format is erroneous. (Custom macro) |
| PS 138 | WHITE STATEMENT FORMAT ERROR | Macro WHITE statement format is erroneous. (Custom macro) |
| PS 139 | SETVN STATEMENT FORMAT ERROR | Macro SETVN statement format is erroneous. (Custom macro) |
| PS 141 | ILLEGAL CHARACTER IN VAR. NAME | An illegal character is being employed for a variable name in SETVN statement. (Custom macro) |
| PS 142 | TOO LONG VARIABLE NAME | A variable name is too long in SETVN statement. (Custom macro) |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| PS 143 | BPRNT/DPRNT STATEMENT FORMAT ERROR | BPRANT or DPRNT statement format is (custom macro external output command) erroneous. |
| PS 144 | G10 FORMAT ERROR | There is an error in the format of G10. |
| PS 145 | F10.1 TIME OUT | Response time of the PC to the G10.1 command is out. |
| PS 146 | G10.1 FORMAT ERROR | There is an error in the format of G10.1. |
| PS 150 | A/D CONVERT ALARM | The A/D converter has mulfunctioned. |
| PS 151 | A/D CONVERT ALARM | The A/D converter has mulfunctioned. |
| PS 180 | ALL PARALLEL AXES IN PARKING | All parallel axes in the same address are parking. (Parking signal is turned on) |
| PS 181 | ZERO RETURN NOT FINISHED | After turning on the power supply, a travel command was specified for an axis with which reference point return has not been finished yet. |
| PS 182 | CIRCLE CUT IN RAPID | F0 (rapid traverse of F1-digit feed or inverse feed) was specified in the circular mode (G02/G03). |
| PS 183 | TOO MANY SIMULTANEOUS CONTROL AXES | A travel command was specified for axes exceeding the simultaneously controllable axes. |
| PS 184 | TOO LARGE DISTANCE | A travel amount exceeded the maximum command value as a result of offset, and so on. |
| PS 185 | ZERO RETURN CHECK (G27) ERROR | The axis specified by G27 (reference point return check) has not returned to the reference point. |
| PS 186 | ILLEGAL PLANE SELECT | A plane select command is erroneous. (Parallel axes were specified simultaneously.) |
| PS 187 | FEED ZONE (COMMAND) | Cutting feedrate command (F code) was 0. |
| PS 188 | FEED ZERO (DRY RUN) | A parameter for maximum feedrate or dry run rate was set to 0. |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| PS 191 | OVER TOLERANCE OF RADIUS | An arc, where the difference of radius values at start point and end point is larger than the parameter set value, was specified. (Parameter 2410) |
| PS 192 | ILLEGAL LEAD COMMAND (G34) | In variable lead thread cutting, a lead incremental/decremental value given by address K is exceeding the maximum command value, or the lead was commanded with a minus sign or exceeding the maximum lead. |
| PS 195 | ILLEGAL AXIS SELECTED (G96) | A P value specified in the G96 block or parameter 5640 value is erroneous. |
| | | |
| PS 200 | PULSE CODER SYNCHRONOUS ERROR | Grid position could not be obtained because no one-revolution signal was applied during deceleration dog ON in grid type reference point return using a digital position detector. |
| PS 270 | OFFSET C START UP CANCEL BY CIR. | Tool nose radius compensation is being started up or cancelled in the circular mode. |
| PS 271 | OFFSET C ILLEGAL PLANE | Plane is being changed during tool nose radius compensation. |
| PS 272 | OFFSET C INTERFERENCE | Too much cutting is cuased in tool nose radius compensation. |
| PS 299 | OFFSET C NO SOLUSION | There is no intersection point in tool nose radius compensation. |
| PS 300 | ILLEGAL ADDRESS | An illegal address was specified when loading parameters or pitch error compensation data from a tape. |
| PS 301 | MISSING ADDRESS | No address was specified when loading parameters or pitch error compensation data from a tape. |
| PS 302 | ILLEGAL DATA NUMBER | A specified data number was erroneous when loading parameters or pitch error compensation data from a tape. |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| PS 303 | ILLEGAL AXIS NUMBER | A specified data number was in error when loading parameters from a tape. |
| PS 304 | TOO MANY DIGITS | The number of digits of data exceeded an allowable value when loading parameters or pitch error compensation data from a tape. |
| PS 305 | DATA OUT OF RANGE | A data value exceeded an allowable value when loading parameters or pitch error compensation data from a tape. |
| PS 306 | MISSING AXIS NUMBER | No axis number was specified when loading parameters requiring the axis specification from a tape. |
| PS 307 | ILLEGAL USE OF MINUS SIGN | Use of data sign was illegal when loading parameters or pitch error compensation data from a tape. |
| PS 308 | MISSING DATA | An address was not followed by a numeric when loading parameters or pitch error compensation data from a tape. |
| PS 400 | PROGRAM NOT MATCH | A tape program does not match a program in the memory. |
| PS 410 | G37 IMPRPER AXIS COMMAND | No axis was specified in the block of tool measurement command, or two or more axes were specified. |
| PS 413 | G37 SPECIFIED WITH T-CODE | A T code was specified in the same block as a tool measurement command. |
| PS 414 | G37 OFFST NO. UNASSIGNED | No T code was specified before the tool measurement command. |
| PS 415 | G37 ARRIVAL SGNL NOT ASSERTED | In tool measurement command, measurement position arrival signal turned "ON" before reaching the area specified by parameter ε. Or, it did not turn "ON" to the end. |
| PS 426 | TOO MANY ADDRESS | Two or more I, (J), K, or R were commanded in the same block as chamfering or corner R. Example) G01X—K—R—; |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| PS 427 | NOT ONE AXIS MOVE WITH I∿R | The block with chamfering or corner R specified is not for one axis travel only. |
| PS 428 | MISMATCH AXIS WITH I∿R | I (K) was specified for X axis (Z axis) command in the block command with chamfering or corner R.<br>G01X—I—; G10Z—K—; |
| PS 429 | MISSING VALUE AT I∿R | A travel distance in the block command with chamfering or corner R is less than a chamfering or corner R amount.<br> |
| PS 430 | CODE ISN'T G10 AFTER I∿R | The command after the block commanded with chamfering or corner R is not G01.<br>Example) N1G01X—K—; N2G00Z—I—; |
| PS 431 | MISSING MOVE AFTER I∿R | The direction or travel distance of the command in the block after the block commanded with chamfering or corner R is odd. The command in the next block is not correct.<br>  <br>Direction Travel distance |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| SR 590 | TH ERROR | TH alarm (A character of disparity error was specified in significant data section.) |
| SR 591 | TV ERROR | TV alarm (The number of characters in one block was not even.) |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| SR 592 | END OF RECORD | EOR (End of Record) was specified halfway in a block. |
| SR 600 | PARAMETER OF RESTART ERROR | There is an error in the parameter of program restart. |
| SR 805 | ILLEGAL COMMAND | An attempt was made to specify an illegal command for RS232C, RS422, PTR interface. This is mainly a system error. |
| SR 806 | DEVICE TYPE MISS MATCH | Such a job as cannot be done by I/O device selected by setting was specified.<br>Example: Heading of a file was specified without using FANUS cassette. |
| SR 807 | PARAMETER SETTING ERROR | An I/O interface unselected as an option was specified, or a set value of setting/parameter related to the I/O interface was erroneous. |
| SR 810 | PTR NOT READY | PTR ready signal turned off. |
| SR 812 | OVERRUN ERROR (PTR) | The next character was received before reading a character received by the PTR. |
| SR 830 | DATA SET READY DOWN (RS232C-2) | Data set ready signal of the RS232-C interface 2 turned off. |
| SR 831 | CARRIER DETECT DOWN (RS232C-2) | Signal quality detection signal of the RS232C interface turned off. |
| SR 832 | OVERRUN ERROR (RS232C-2) | The next character was received before reading a character received by the RS232C interface 2. |
| SR 833 | FRAMING ERROR (RS232C-2) | No stop bit of a character received by the RS232C interface 2 was detected. |
| SR 834 | BUFFER OVERFLOW (RS232C-2) | Data exceeding 10 characters were received after sending stop code (DC3) when the NC unit receives data by the RS232C interface 2. |
| SR 840 | DATA SET READY DOWN (RS232C-3) | Data set ready signal of the RS232-C interface 3 turned off. |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| SR 841 | CARRIER DETECT DOWN (RS232C-3) | Signal quality detection signal of the RS232C interface 3 turned off. |
| SR 842 | OVERRUN ERROR (RS232C-3) | The next character was received before reading a character received by the RS232C interface 3. |
| SR 843 | FRAMING ERROR (RS232C-3) | No stop bit of a character received by the RS232C interface 3 was detected. |
| SR 844 | BUFFER OVERFLOW (RS232C-3) | Data exceeding 10 characters were received after sending stop code (DC3) when the NC received data by the RS232C interface 3. |
| SR 850 | DNC NOT READY | DNC ready signal turned off. |
| SR 852 | OVERRUN ERROR (DNC) | The next character was received before reading a character received by the DNC. |
| SR 860 | DATA SET READY DOWN (ASR33/43) | Data set ready signal of the 20mA current loop interface turned off. |
| SR 861 | CARRIER DETECT DOWN (ASR33/43) | Signal quality detection signal of the RS232C interface 3 turned off. |
| SR 862 | OVERRUN ERROR (ASR33/43) | The next character was received before reading a character received by the 20mA current loop interface. |
| SR 863 | FRAMING ERROR (ASR33/43) | No stop bit of a character received by the 20mA current loop interface was detected. |
| SR 864 | BUFFER OVERFLOW (ASR33/44) | More than 10 characters were received after sending stop code (DC3) when the NC unit receives data by the 20mA current loop interface. |
| SR 870 | DATA SET READY DOWN (RS422) | Data set ready signal of the RS422 interface turned off. |
| SR 871 | CARRIER DETECT DOWN (RS422) | Signal quality detection signal of the RS422 interface turned off. |
| SR 872 | OVERRUN ERROR (RS422) | The next character was received before reading a character received by the RS422 interface. |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| SR 873 | FRAMING ERROR (RS422) | No stop bit of a character received by the RS422 interface was detected. |
| SR 874 | BUFFER OVERFLOW (RS422) | More than 10 characters were received after sending stop code (DC3) when the NC unit receives data by the RS422 interface. |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| OH 000 | MOTOR OVERHEAT | The servo motor is overheated. |
| OH 001 | LOCKER OVERHEAT | The NC cabinet is overheated. |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| SW 000 | PARAMETER ENABLE SWITCH ON | Parameters are settable. (Parameter: Data No. 8000 PWE = 1) |
| SW 010 | BUBBLE FREE MODE AVAILABLE | The free mode switch of the bubble memory was turned on. |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| SB 010 | GRAPHIC ROM PARITY | A parity error occurred in graphic ROM. |
| SB 011 | GRAPHIC RAM PARITY (WORK) | A parity error occurred in graphic work RAM. |
| SB 011 | GRAPHIC RAM PARITY (RED) | A parity error occurred in graphic red RAM. |
| SB 011 | GRAPHIC RAM PARITY (GREEN) | A parity error occurred in graphic green RAM. |
| SB 011 | GRAPHIC RAM PARITY (BLUE) | A parity error occurred in graphic blue RAM. |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| OT 001 | + OVERTRAVEL (SOFT 1) | When the tool was moving in the plus direction, it entered the forbidden area of stored stroke limit 1. |
| OT 002 | - OVERTRAVEL (SOFT 1) | When the tool was moving in the minus direction it entered the forbidden area of stored stroke limit 1. |
| OT 003 | + OVERTRAVEL (SOFT 2) | When the tool was moving in the plus direction it entered the forbidden area of stored stroke limit 2. |
| OT 004 | - OVERTRAVEL (SOFT 2) | When the tool was moving in the minus direction it entered the forbidden area of stored stroke limit 2. |
| OT 005 | + OVERTRAVEL (SOFT 3) | When the tool was moving in the plus direction it entered the forbidden area of stored stroke limit 3. |
| OT 006 | - OVERTRAVEL (SOFT 3) | When the tool was moving in the minus direction it entered the forbidden area of stored stroke limit 3. |
| OT 007 | + OVERTRAVEL (HARD) | The plus stroke limit switch was stepped on. |
| OT 008 | - OVERTRAVEL (HARD) | The minus stroke limit switch was stepped on. |
| OT 021 | + OVERTRAVEL (PRE-CHECK) | The tool entered the forbidden area of the "+" direction in a stroke check before travel. |
| OT 022 | - OVERTRAVEL (PRE-CHECK) | The tool entered the forbidden area of the "-" direction in a stroke check before travel. |
| OT 100 | SPINDLE ALARM | Spindle motor alarm signal turned on. A code indicating an alarm cause is 0. |
| OT 101 | SPINDLE MOTOR OVERHEAT | The spindle motor is overheated. |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| OT 102 | EXCESS VELOCITY ERROR | A deviation is excessive between a commanded spindle speed and an actual spindle speed. (15 - 20%) |
| OT 103 | FUSE F7 BLEW | The fuse F7 of the spindle motor speed control unit was blown. |
| OT 104 | FUSE F1, F2, OR F3 BLEW | The fuse F1, F2 or F3 of the spindle motor speed control unit was blown. |
| OT 105 | FUSE AF2 OR AF3 BLEW | The fuse AF2 or AF3 of the spindle motor speed control unit was blown. |
| OT 106 | EXCESS VELOCITY (ANALOG) | A spindle motor speed exceeded the maximum rating. (Analog detection) |
| OT 107 | EXCESS VELOCITY (DIGITAL) | A spindle motor speed exceeded the maximum rating. (Digital detection) |
| OT 108 | VOLTAGE (+24V) TOO HIGH | The 24V voltage of the spindle motor speed control unit is higher than specified. |
| OT 109 | POWER SEMICONDUCTOR OVERLOAD | A power semiconductor is overheated. |
| OT 110 | VOLTAGE (+15V) TOO LOW | The 15V voltage of the spindle speed control unit is lower than specified. |
| OT 111 | VOLTAGE EXCESS (DC LINK) | The voltage at the DC link area of the spindle motor speed control unit is too high. |
| OT 112 | CURRENT EXCESS (DC LINK) | A current flows excessively to the DC link area of the spindle motor speed control unit. |
| OT 113 | CPU ERROR | The CPU or peripheral circuit of the spindle motor speed control unit is defective. |
| OT 114 | ROM ERROR | The ROM of the spindle motor speed control unit is defective. |
| OT 115 | OPTION ALARM | Auxiliary alarm for the spindle motor |
| OT 116 | DISCONNECTION POS CODER | The position coder was detected to have been disconnected. |

| Error code | Message dispalyed on CRT | Contents |
|---|---|---|
| OT 120 | UNASSIGNED ADDRESS (HIGH) | An undefined address (high division) was specified for high-order 4 bits (EIA4 - EIA7) of the address signal of the external data I/O interface. |
| OT 121 | UNASSIGNED ADDRESS (LOW) | An undefined address (low division) was specified for lower-order 4 bits (EIA0 - EIA3) of the address signal of the external data I/O interface. |
| OT 122 | TOO MANY MESSAGE | It was requested to display five or more external operator messages or external alarm messages simultaneously. |
| OT 123 | MESSAGE NUMBER NOT FOUND | An external operator message or external alarm message cannot be cancelled, because the specified message number is missing. |
| OT 124 | OUTPUT REQUEST ERROR | An output request was made again during external data output, or it was made to an address which has no output data. |
| OT 125 | TOO LARGE NUMBER | A numeral other than 0 - 999 was specified as an external operator message or external alarm message number. |
| OT 126 | SPECIFIED NUMBER NOT FOUND | The program number of external data input, or the number specified in sequence number search is not found. Or, the program number specified in work number search is not found. |
| OT 127 | DI. EIDHW OUT OF RANGE | The value input by data signal EID32-EID47 for external data input is out of an allowable range. |
| OT 128 | DI. EIDLL OUT OF RANGE | The value input by data signal EID0-EID31 for external data input is out of an allowable range. |
| OT 130 | SEARCH REQUEST NOT ACCEPTED | A request for program number search or sequence number search is not accepted. (due to not MEMORY mode or being reset). |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| PC 010 | PC ERROR | PC ROM parity error occurred. |
| PC 020 | PC ERROR | PC RAM parity error occurred. |
| PC 030 | PC ERROR | The I/O units were not correctly allocated. |
| PC 500 | WATCH DOG ALARM | PC watch dog alarm occurred. |
| PC 510 | MIC TYPE MISS MATCH | Type of MIC (Machine interface converter) does not match with one specified by PC. |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| SV 000 | TACHOGENERATOR DISCONNECT | Tachogenerator disconnection alarm was detected. |
| SV 001 | MOTOR OVERLOAD | Servo motor was detected to have been overloaded. (Overload) |
| SV 002 | VELOCITY-UNIT BREAKER OFF | A velocity control circuit breaker was turned off. |
| SV 003 | EXCESS CURRENT IN SERVO | An overcurrent was detected in the velocity control circuit. |
| SV 004 | EXCESS VOLTAGE IN SERVO | An overvoltage was detected in the velocity control circuit. |
| SV 005 | EXCESS DISCHARGE CURRENT | An excessive regenerative current was detected in the velocity control circuit. |
| SV 006 | VELOCTY-UNIT POWER TOO LOW | A low voltage was detected in the velocity control curcuit. |
| SV 008 | EXCESS ERROR (STOP) | A position deviation amount during stop is larger than the value set by the parameter No. 1829. |
| SV 009 | EXCESS ERROR (MOVING) | A position deviation amount during travel is larger than the value set by the parameter No. 1828. |
| SV 010 | EXCESS DRIFT COMPENSATION | A drift amount is excessive. (More than 500VELO) |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| SV 011 | LSI OVERFLOW | A position deviation amount exceed ±32767, or the velocity command value of the DA converter is out of a range of -8912 +8912. This error is usually caused by various setting failures. |
| SV 012 | MOTION VALUE OVERFLOW | A velocity exceeding 512K pulse/sec (frequency converted into detection unit) was specified. This error is caused by a parameter CMR or feed-rate setting failure. |
| SV 013 | IMPROPER V-READY OFF | Velocity control ready signal (VRDY) turned off when position control ready signal (PRDY) is turned on. |
| SV 014 | IMPROPER V-READY OFF | Velocity control ready signal (VRDY) was turned on when position control ready signal (PRDY) is turned off. |
| SV 015 | PULSE CODER DISCONNECT | The coder was detected to have been disconnected. |
| SV 017 | ILL POSITION CONTROL LSI | A position control LSI trouble was detected. |
| SV 018 | UNFIT DSCG FREQUENCY | An abnormality was detected in resolver or industosyn feedback frequency check. |
| SV 019 | UNFIT PULSE OF PULSE CODER | An abnormality was detected in the feedback pulse from the pulse coder. |
| SV 020 | UNFIT PHASE SHIFT VALUE | A phase shift amount of the resolver or industosyn could not be obtained correctly. |
| SV 021 | UNFIT PULSE CODER 1 REV ON | One-revolution signal of the pulse coder was turned on at an abnormal position. |
| SV 022 | PULSE CODER 1 REV MISSING | One-revolution signal of the pulse coder was not turned on within an allowable range. |
| SV 023 | SV OVER LOAD | Servo motor was detected to have been overloaded. |
| SV 025 | V-READY ON (INITIALIZING) | Velocity control ready signal (VRDY) was turned on instead of being turned off when servo control was turned on. |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| SV 026 | ILLEGAL AXIS ARRANGE | Parameter No. 1023 for servo axis arrangement was not set properly. |
| SV 030 | EMERGENCY STOP | An emergency stop was applied. (In case of parameter 2001 ENR=1) |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| IO 000 | BUBBLE DATA BUS PARITY ERROR | A parity error of the bubble memory bus was detected. |
| IO 001 | BUBBLE TIME OUT ERROR | A bubble memory read/write time-out error was detected. |
| IO 002 | BUBBLE ILLEGAL COMMAND ISSED | A command undefined in the bubble memory control circuit was written. |
| IO 003 | BUBBLE TRANSFER MISSING | Bubble memory data was not properly transferred. |
| IO 010 | BUBBLE MAP LOOP BROKEN | Bubble memory map loop was broken. |
| IO 011 | BUBBLE IS ERASED OR UNLOADED | The bubble memory was erased. |
| IP 020 | BUBBLE TOO MANY PARITY PAGES | One-bit parity occurred and the number of automatically corrected pages exceeded 16. |
| IO 021 | BUBBLE DATA PARITY ERROR | A parity error was detected when data was read from the bubble memory. |
| IO 022 | BUBBLE WRITE PROTECTED | An attempt was made to write data into the forbidden area of the bubble memory. |
| IO 030 | CHECK·SUM ERROR | Check sum in page unit of the NC memory is erroneous. |
| IO 031 | INVALID CODE | An invalid code was read out of the NC memory. |
| IO 032 | MEMORY ACCESS OVER RANGE | An attempt was made to write data to or read data from an address which is outside the NC memory area. |

| Error code | Message displayed on CRT | Contents |
|---|---|---|
| PW 000 | POWER MUST BE OFF | A parameter, for which the power must be turned off once, was set. |

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Industrial Division
444-334 CNC Turning Center Operations and Prove Out

**Unit 4**

**Point to Point and Linear Interpolation**

INTRODUCTION

In this unit you will perform a setup and prove out of a CNC program utilizing point to point and linear interpolation programming methods. These projects will be the same ones you have documented in the Manual Programming Turn 1 course.

OBJECTIVES

1. Setup tooling per tool list.
2. Setup workholding device per setup sheet.
3. Prove out program incorporating point to point and linear interpolation axis moves.
4. Avoid collisions, recover from errors and safely restart program.
5. Document program corrections.
6. Describe typical program format errors which result in alarms or partial loading of programs from the tape.

CONTENTS

Reference Section:

Section 1 Loading a program from a tape.

Section 2 Program format errors.

Section 3 Documenting edits.

Assignment Section:

Review

Project Section:

Project No. NC333.1
Project No. NC333.2

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**SECTION 1**

**LOADING A PROGRAM FROM TAPE**

1. Set the mode select switch to edit.
2. Press the Function Key to display the main menu.
3. Press PRGRM Soft Key.
4. Press Operations Key until the word READ appears in the menu.
5. Load the tape into the paper tape reader with the sprocket holes located away from the machine. Ensure that the man-readable portion of the tape is to the left of the read head.
6. Flip the hinged read head down closing on top of the tape. Toggle the switch, at the right, upwards to the AUTO position.
7. At the CRT, press the READ Soft Key.
8. Press the ONE PROGRAM Soft Key.
9. Press the NEW Soft Key.
10. The tape should be read in at this time and lines of program code should appear on the CRT.
11. Compare the program displayed on the CRT with the program manuscript to verify that everything was read in correctly.

TROUBLE SHOOTING

A. If the tape doesn't move and the words 'READ' or Stop Read are flashing on the CRT then the paper tape reader has been deselected as the input device. To select the paper tape reader follow these steps:

   1. Display the main menu and press SETTING soft key.
   2. Press HANDY soft screen.
   3. Check the display for the input device status. It

should be zero for PTR (paper tape reader). Use the cursor keys to position to the value.

4. Turn key to write protect OFF.

5. Set mode selector switch to MDI.

6. Enter the number 0.

7. Press the INPUT soft key.

B. If the tape feeds through, but the program code is not displayed on the CRT, then check the tape to verify that the sprocket holes are away from the machine.

C. If alarm SR 591 is activated the control sensed a parity problem.

1. Look at the tape and make sure it was punched in even parity.

2. If the tape is okay then go to the HANDY display and make sure the EIA has been selected.

3. If 1 and 2 above were okay then make sure that the man-readable portion of the tape was not read by the tape reader.

4. If the problem still occurs then punch a new tape.

D. If only a part of the program was read into the control then, check your program manuscript at the point where the control stopped reading it. The ONE-PROGRAM selection will read in only one program from the tape so if there are any letter 'O's where there should be a number 0 the control will interpret this as the beginning of another program and stop reading.

**SECTION 2**

**PROGRAM FORMAT ERRORS**

Standardizing on a programming structure which employs a proper program format will make the task of reading program manuscripts much easier for the programmer or operator who did not write that particular program. It increases the chances of spotting program format errors because deviations from a standard structure are easily recognized. It also develops a good habit in the program writer because the program coding becomes automatic as the program structure is practiced over and over again.

During prove out one of the first things the programmer/operator does is inspect the program manuscript for errors and to become familiar with what the programmer is intending to do. The standardized program structure will allow this to happen in a quicker and more thorough manner. The program format will be presented in your Manual Programming Turn 1 class.

**SECTION 3**

**DOCUMENTING EDITS**

During the prove out process it may be necessary to make programming changes. Any changes made to the program in the control should be recorded immediately on the program manuscript. This will help the operator during prove out to spot where changes are and where to pay special attention during the first time execution of the edits. These recorded edits are also used to communicate and alert the next operator to run the program or the programmer who will update all the documentation.

At times certain program sections will have to be edited more than once to get the machining to work. Therefore it is essential that the editing is performed neatly and organized.

1. Mark up the hard copy printout of the program only.

2. Use a pencil or red pencil, not ink.

3. When changing a word or words in a program line, draw one line through it or circle it and draw a leader horizontally to the right and clearly print both the word address and number value of each word. Never blot out original text. Never cross out just one number of a value and write in only that value. Never try to squeeze in an edited word between words or between lines. Never write on top of original text.

4. When adding a word, draw a short vertical bar in the position of the program code where it should be inserted, then draw a leader to the right and print the new word.

5. When deleting a single word or a whole line, draw a single horizontal line through the complete word, words or line. Never blot it out.

6. When inserting a new program line, draw a horizontal line starting at a position after the line it will follow and extending into the left margin, terminating horizontally to the right of the program code. Then write the new line starting at this point. Never try to squeeze the new line in the space between original lines of text.

7. When editing the edits, use the same rules outlined above. See Figure 3-2.

```
%
O3260(BASE, SEMI-FIN)
G91G28Z0
G00G49G90
G17G20G40G49G80
G00G54B0.0
M28
N0001T1M06(1" HAWG END MILL)
G90M21
G00G54X-.75Y1.25S400M03
G43H1Z-.5M21
G01X6.6F5.0M08
G00Z2.0
G91G28Z0
G49M09
M01
N0002T2M06(1/2" HAWG END MILL)
G90M21
G00G54X-.5Y1.25S800M03
G43H2Z-.875
G01X6.35F9.6M08
G01X6.35F9.6M08
G00Z2.0
G91G28Z0
G49M09
M01
N0003T3M06(7/8" END MILL)
G90M21
G00G54X-1.25Y2.5
G43H3D33Z-.525S570M03
G01G42X0Y1.815F50.0M08
X7.0F11.4
Y.685
X-1.0
G00G40X-1.25Y2.5
Z2.0
G91G28Z0
G49M09
M01
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Figure 3-2

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

PROJECT SECTION:

Setup and proveout the programs for part numbers NC333-1 and NC333-2. Use the following data sheets when completing your setups and having your instructor inspect your parts.

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

print

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

| CNC PROGRAM PROVE OUT EVALUATION | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | Unit No. | | Student | | |
| Part Name | | Mach.No. | | Date | | |
| Work Zero Offset | G | X | Z | | | Eval |
| | | | | | | 5 |
| Workholding | Hard Jaws Soft Jaws Face Plate<br>Assembled Machined | | | | | 5 |
| Tool Length Offset Geometry | | | | | | |
| Tool No. | G50 or G54 | | Assm. | Ver. | In Pkt. | 10 |
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| Prove Out | Collision Broken Tool Scrapped Part Damaged Part | | | | | 20 |
| | Fluid Low: Hyd Way Coolant | | | | | |
| | List Alarms: | | | | | |
| | Speeds: Low High OK | | | | | |
| | Feeds: Low High OK | | | | | |
| Document-ation | Legible Logical | | | | | 10 |
| | | | | | Total | |

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

| Inspection Report | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | Student | | Date | | Eval |
| Edge Location | | | Finish | | | 10 |
| Nominal Dimension | Tolr. | Actual Dimension | Out of Tolr. | Comment | | 40 |
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MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

print

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

| CNC PROGRAM PROVE OUT EVALUATION | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | Unit No. | | Student | | |
| Part Name | | Mach.No. | | Date | | |
| Work Zero Offset | G | X | Z | | | Eval |
| | | | | | | 5 |
| Workholding | Hard Jaws Soft Jaws Face Plate<br>Assembled Machined | | | | | 5 |
| Tool Length Offset Geometry | | | | | | |
| Tool No. | G50 or G54 | | Assm. | Ver. | In Pkt. | 10 |
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| Prove Out | Collision Broken Tool Scrapped Part Damaged Part | | | | | 20 |
| | Fluid Low: Hyd Way Coolant | | | | | |
| | List Alarms: | | | | | |
| | Speeds: Low High OK | | | | | |
| | Feeds: Low High OK | | | | | |
| Documentation | Legible Logical | | | | | 10 |
| | | | | | Total | |

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

| Inspection Report | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | Student | | Date | | Eval |
| Edge Location | | | Finish | | | 10 |
| Nominal Dimension | Tolr. | Actual Dimension | Out of Tolr. | Comment | | 40 |
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MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

Unit 5

Setup and Prove Out: Tool Nose Radius Compensation

INTRODUCTION

In this unit you will perform a setup and prove out of two more CNC programs while being introduced to the concepts of tool nose radius compensation. These projects will be the same ones you have documented in the Manual Programming Turn 1 course.

OBJECTIVES

1. Prove out a program with tool nose radius compensation.

CONTENTS

Project Section:

Project No. NC333.3
Project No. NC333.4

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

PROJECT SECTION:

Setup and proveout the programs for part numbers NC333-3 and NC333-4. Use the following data sheets when completing your setups and having your instructor inspect your parts.

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

print

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

| CNC PROGRAM PROVE OUT EVALUATION | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | Unit No. | | Student | | |
| Part Name | | Mach.No. | | Date | | |
| Work Zero Offset | G | X | Z | | | Eval |
| | | | | | | 5 |
| Workholding | Hard Jaws Soft Jaws Face Plate<br>Assembled Machined | | | | | 5 |
| Tool Length Offset Geometry | | | | | | |
| Tool No. | G50 or G54 | | Assm. | Ver. | In Pkt. | 10 |
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| Prove Out | Collision Broken Tool Scrapped Part Damaged Part | | | | | 20 |
| | Fluid Low: Hyd Way Coolant | | | | | |
| | List Alarms: | | | | | |
| | Speeds: Low High OK | | | | | |
| | Feeds: Low High OK | | | | | |
| Documentation | Legible Logical | | | | | 10 |
| | | | | | Total | |

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

| Inspection Report | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | Student | | Date | | Eval |
| Edge Location | | | Finish | | | 10 |
| Nominal Dimension | Tolr. | Actual Dimension | Out of Tolr. | Comment | | 40 |
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MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

print

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

| CNC PROGRAM PROVE OUT EVALUATION | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | Unit No. | | Student | | |
| Part Name | | Mach.No. | | Date | | |
| Work Zero Offset | G | X | Z | | | Eval |
| | | | | | | 5 |
| Workholding | Hard Jaws Soft Jaws Face Plate<br>Assembled Machined | | | | | 5 |
| Tool Length Offset Geometry | | | | | | |
| Tool No. | G50 or G54 | | Assm. | Ver. | In Pkt. | 10 |
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| Prove Out | Collision Broken Tool Scrapped Part Damaged Part | | | | | 20 |
| | Fluid Low: Hyd Way Coolant | | | | | |
| | List Alarms: | | | | | |
| | Speeds: Low High OK | | | | | |
| | Feeds: Low High OK | | | | | |
| Document-ation | Legible Logical | | | | | 10 |
| | | | | | Total | |

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

| Inspection Report | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | Student | | Date | | Eval |
| Edge Location | | | Finish | | | 10 |
| Nominal Dimension | Tolr. | Actual Dimension | Out of Tolr. | Comment | | 40 |
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MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

Unit 6

Setup and Prove Out: Cutter Compensation

INTRODUCTION

In this unit you will perform a setup and prove out of a CNC program utilizing circular interpolation methods. Collision avoidance methods and error recovery with program restart will vary with the different modes of operation. These projects will be the same ones you have documented in the Manual Programming Turn 1 course.

OBJECTIVES

1. Prove out a program utilizing circular interpolation.

2. Safely restart a program which has been interrupted prior to completing all operations.

CONTENTS

Project Section:

Project No. NC333.5
Project No. NC333.6

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

PROJECT SECTION:

Setup and proveout the programs for part numbers NC333-5 and NC333-5. Use the following data sheets when completing your setups and having your instructor inspect your parts.

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

print

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

| CNC PROGRAM PROVE OUT EVALUATION | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | Unit No. | | Student | | |
| Part Name | | Mach.No. | | Date | | |
| Work Zero Offset | G | X | Z | | | Eval |
| | | | | | | 5 |
| Workholding | Hard Jaws Soft Jaws Face Plate<br>Assembled Machined | | | | | 5 |
| Tool Length Offset Geometry | | | | | | |
| Tool No. | G50 or G54 | | Assm. | Ver. | In Pkt. | 10 |
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| Prove Out | Collision Broken Tool Scrapped Part Damaged Part | | | | | 20 |
| | Fluid Low: Hyd Way Coolant | | | | | |
| | List Alarms: | | | | | |
| | Speeds: Low High OK | | | | | |
| | Feeds: Low High OK | | | | | |
| Document-ation | Legible Logical | | | | | 10 |
| | | | | | Total | |

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

| Inspection Report | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | Student | | Date | | Eval |
| Edge Location | | | Finish | | | 10 |
| Nominal Dimension | Tolr. | Actual Dimension | Out of Tolr. | Comment | | 40 |
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MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

print

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

| CNC PROGRAM PROVE OUT EVALUATION | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | Unit No. | | Student | | |
| Part Name | | Mach.No. | | Date | | |
| Work Zero Offset | G | X | Z | | | Eval |
| | | | | | | 5 |
| Workholding | Hard Jaws Soft Jaws Face Plate<br>Assembled Machined | | | | | 5 |
| Tool Length Offset Geometry | | | | | | |
| Tool No. | G50 or G54 | | Assm. | Ver. | In Pkt. | 10 |
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| Prove Out | Collision Broken Tool Scrapped Part Damaged Part | | | | | 20 |
| | Fluid Low: Hyd Way Coolant | | | | | |
| | List Alarms: | | | | | |
| | Speeds: Low High OK | | | | | |
| | Feeds: Low High OK | | | | | |
| Document-ation | Legible Logical | | | | | 10 |
| | | | | | Total | |

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

| Inspection Report | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | Student | | Date | | Eval |
| Edge Location | | | Finish | | | 10 |
| Nominal Dimension | Tolr. | Actual Dimension | Out of Tolr. | Comment | | 40 |
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MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

Unit 7

Setup and Prove Out: Metric Parts

INTRODUCTION

In this unit you will perform a setup and prove out of a CNC program utilizing metric units of millimeters for positional data. Collision avoidance methods and error recovery with program restart will be discussed if problems are encountered. These projects will be the same ones you have documented in the Manual Programming Turn 1 course.

OBJECTIVES

1. Prove out a program utilizing metric coordinates.

2. Safely restart a program which has been interrupted prior to completing all operations.

CONTENTS

PROJECT SECTION:
Project No. NC333.7
Project No. NC333.8

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

PROJECT SECTION:

Setup and proveout the programs for part numbers NC333-6 and NC333-7. Use the following data sheets when completing your setups and having your instructor inspect your parts.

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

print

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

| CNC PROGRAM PROVE OUT EVALUATION | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | Unit No. | | Student | | |
| Part Name | | Mach.No. | | Date | | |
| Work Zero Offset | G | X | Z | | | Eval |
| | | | | | | 5 |
| Workholding | Hard Jaws Soft Jaws Face Plate<br>Assembled Machined | | | | | 5 |
| Tool Length Offset Geometry | | | | | | |
| Tool No. | G50 or G54 | | Assm. | Ver. | In Pkt. | 10 |
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| Prove Out | Collision Broken Tool Scrapped Part Damaged Part | | | | | 20 |
| | Fluid Low: Hyd Way Coolant | | | | | |
| | List Alarms: | | | | | |
| | Speeds: Low High OK | | | | | |
| | Feeds: Low High OK | | | | | |
| Documentation | Legible Logical | | | | | 10 |
| | | | | | Total | |

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

| Inspection Report | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | Student | | Date | | Eval |
| Edge Location | | | Finish | | | 10 |
| Nominal Dimension | Tolr. | Actual Dimension | Out of Tolr. | Comment | | 40 |
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MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

print

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

| CNC PROGRAM PROVE OUT EVALUATION | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | Unit No. | | Student | | |
| Part Name | | Mach.No. | | Date | | |
| Work Zero Offset | G | X | Z | | | Eval |
| | | | | | | 5 |
| Workholding | Hard Jaws Soft Jaws Face Plate<br>Assembled Machined | | | | | 5 |
| Tool Length Offset Geometry | | | | | | |
| Tool No. | G50 or G54 | | Assm. | Ver. | In Pkt. | 10 |
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| Prove Out | Collision Broken Tool Scrapped Part Damaged Part | | | | | 20 |
| | Fluid Low: Hyd Way Coolant | | | | | |
| | List Alarms: | | | | | |
| | Speeds: Low High OK | | | | | |
| | Feeds: Low High OK | | | | | |
| Document-ation | Legible Logical | | | | | 10 |
| | | | | | Total | |

MILWAUKEE AREA TECHNICAL COLLEGE
Industrial Division
444-334 CNC Turning Center Operations and Prove Out

| Inspection Report | | | | | | |
|---|---|---|---|---|---|---|
| Prog. No. | | Student | | Date | | Eval |
| Edge Location | | | Finish | | | 10 |
| Nominal Dimension | Tolr. | Actual Dimension | Out of Tolr. | Comment | | 40 |
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